GENERATION OF AGROTECHNOLOGY FOR LIVELIHOOD IMPROVEMENT OF THE HAOR COMMUNITY

Justification

The *haor* of Bangladesh covers the districts of Kishoreganj (eastern part), Netrokona, Sunamganj, Habiganj, Moulabibazar and part of Sylhet and Brahmanbaria of area about 932793 hectares extends as many as 43 upazilas of the aforesaid districts. The *haors* go under flooding (5-10 m) from late May to October while it looks like a sea. The objectives of the project are increasing productivity of field crops, vegetable, livestock and fishes in a household through the use of appropriate technologies and techniques devised/ developed/ designed/ refined with participation of project beneficiaries. The ultimate goal of the project is to ensure household food security and nutritional upliftment and raise income through diversifying enterprises, mobilizing resources and intensifying farming and non farming activities, *in situ* employment generation, conserving farm environment through efficient mobilization and management of natural resources for sustainable production systems, developing human resources for capacity building of the participants and improving their livelihood through system approach. The Livelihood Improvement of Farming Community in *Haor* Area through System Approach (LIFCHASA) Project of the Bangladesh Agricultural University, Mymensingh has started functioning in Purbo Tethulia village of Mohanganj upazila, Netrakona district since April, 2010 with the financial assistance from the National Agricultural Technology Project, SPGR Subproject, Bangladesh Agricultural Research Council.

A Traditional Planting System of Indigenous Hizal Tree for Protecting Homestead Wave thrust

Homestead scenario of *haor* area during monsoon season

Methodology

The Bench Mark Survey was conducted in Purbo Tethulia to generate basic information, identification of problems, researchable issues and key issues related to Crop and Agroforestry, Livestock and Fisheries Systems including Economic and Social Aspects of Livelihood Systems. Farmer selection for different activities was done for activities as planned. The experiments were done by participation with male and female farm family. The project has by this time successfully completed 61 research/development activities which have been generated a number of very promising technologies developed/refined by the participants' farmers and the scientists through participatory zeal and spirit. The activities were implemented through disciplined, commodity and systems oriented participatory on-farm and on-station training to make them resourceful and efficient in handling research methodology and become resourceful entrepreneur.

Achievements

Crop and Agroforestry Component

Summer and winter vegetable production in homestead

The study was carried out in 462 households during 2011-12. In the summer, lady's finger (Hi-soft), Indian spinach (Puishak shabuj), sweet gourd (Shotabdi, F1), ash gourd (Super Star, F1), yard long bean (Kegornatoki), snake gourd (Kobra, F1) and in the winter, country bean of three varieties Knoldog, Knoli, IPSA-1, three varieties of Bottle gourd Hi-green, Martina, Madhumoti (Hybrid) were cultivated with improved management practices Gross margin of the trial for one year was Tk. 1073549 of total 462 households of the community.

Table 1 Agro-economic productivity of summer and winter vegetable in the homestead

Vegetable	Production farm^{-1} (kg/no.)	Gross return Tk farm^{-1}	Gross margin Tk farm^{-1}
Indian spinach	27.5kg	412	362.50
Sweet gourd	12.76no.	319	269.00
Ash gourd	19.62no.	392	342.40
Snake gourd	23.99kg	479	429.80
Bottle gourd	24no.	480	400
Country bean	30 kg	600	520
Total of the trials	-	1438668	1073549

Community trial for fruit and timber tree plantation

The study was undertaken to increase homestead fruit production, to increase households' intake of fruit,to meet up family need of wood and to utilize fallow land of homestead area. Saplings of Mango (Amropaly), jujube (BAU kul-1 and apel kul), lemon (Elachi and Baromashi), guava(Madhury), papaya (Kashimpuri and Red lady), mehogini and lambu were supplied among the 462 households and litchi (China 3) in selected 50 households of Purbo Tethulia.

Timber tree species are now at growing stage. Among the fruit trees mango, guava, litchi are at growing stage and papaya, jujube and lemon are at bearing stage.

Crop intensification and diversification in rice based cropping patterns in *haor* ecosystem

The study was carried out during October 2010 to May 2011 and consisted of six treatments of cropping patterns such as:
i. Potato-Boro rice- Land under seasonal flood ii.Red amaranth-*Boro* rice- Land under seasonal flood iii. Stem amaranth-*Boro* rice- Land under seasonal flood iv. Spinach- *Boro* rice- Land under seasonal flood v. Radish- *Boro* rice- Land under seasonal flood vi. Mustard- *Boro* rice- Land under seasonal flood. The highest gross margin Tk.170459 was obtained from the Potato-Boro rice- Land under seasonal flood pattern.

Table 2 Effect of cropping pattern on agro-economic productivity

Cropping pattern	Total grain yield (rice equivalent)	Total variable cost (tkha^{-1})	Gross margin (tkha^{-1})
Potato-Boro rice-Fallow	22.41 a	193703	170459
Red amaranth-Boro rice-Fallow	15.47 c	165600	86112
Stem amaranth-Boro rice-Fallow	17.04 b	167818	109082
Spinach-Boro rice-Fallow	17.97 b	172788	119224
Radish-Boro rice-Fallow	22.10 a	205214	153911
Mustard-Boro rice-Fallow	11.56 e	167723	20127

Potato Tk.12 kg^{-1}, Red amaranth Tk.10 kg^{-1}, Stem amaranth Tk.6 kg^{-1},SpinachTk. 12 kg^{-1}, RadishTk.4 kg^{-1}, Mustard Tk.40 kg^{-1}, Rice Tk.16.25 kg^{-1}, Mustard strawTk.1 kg^{-1}, Rice straw Tk.1 kg^{-1}

Yield performance of inbred and hybrid boro rice varieties in *haor* area

An experiment was conducted including three inbred varieties of *boro* rice namely BRRIdhan28, BRRIdhan29 and BRRIdhan 45, and four hybrid varieties namely ACI Shera, ACI 2, Hira 2 and SL 8H in five farmers' fields in Purbo Tethulia during 2010-2011. The highest yield was found from BRRIdhan 29 (9.73 t ha^{-1}).

Table 3 Agro-economic performance of rice varieties

Variety	Grain yield t ha^{-1}	Straw yield t ha^{-1}	Total variable cost (t ha^{1})	Gross margin (Tk ha^{1})	Total growth duration (Days)
BRRI dhan28	8.90	10.33	55000	99955	141
BRRI dhan29	9.73	11.06	55000	114173	156
BRRI dhan45	6.95	8.76	55000	66638	135
ACI 2	9.59	11.31	63500	96455	146
ACI Shera	9.49	10.98	63500	94575	148
Hira 2	9.44	10.98	63500	93800	146
SL 8H	10.07	10.52	63500	103105	146
Farmer BRRI dhan28	7.46	10.16	52000	73790	141
Farmer BRRI dhan29	8.01	10.82	52000	82215	156

Inbred *boro* rice (BRRI dhan28, 29, 45)-Tk. 16.25 kg^{-1}, hybrid *boro* rice Tk.15.50 kg^{-1}, straw Tk. 1.00 kg^{-1}.

Productivity of Tomato-Stem amaranth- Land under seasonal flood, Cabbage-Lady's finger- Land under seasonal flood and Cauliflower-Indian spinach- Land under seasonal flood in Haor Ecosystem

With a view to increase vegetable production and to turn the single cropped area into double cropped area of Purbo Tethulia the study was carried out during October 2011 to March 2011 including Tomato-Stem amaranth- Land under seasonal flood, Cabbage-Lady's finger- Land under seasonal flood and Cauliflower-Indian spinach- Land under seasonal flood cropping pattern. Stem amaranth, lady's finger, indian spinach was cultivated after harvesting tomato, cabbage and cauliflower. Highest gross margin of Tk.ha^{-1} 233720 was found in case of Tomato-Stem amaranth- Land under seasonal flood cropping pattern.

Table 4 Agro-economic performance of winter vegetable

Vegetable/ spices	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})
Tomato-Stem amaranth- Land under seasonal flood	234530	233720
Cabbage-Lady's finger- Land under seasonal flood	239725	207480
Cauliflower-Indian spinach- Land under seasonal floodg	211200	201360

Tomato- 10 Tk. kg^{-1}, Cabbage-8 Tk. kg^{-1}, Cauliflower-10 Tk. kg^{-1}

Performance of Three Duck Breeds Khaki Campbell, Jinding and Deshi in the Haor area

A study was conducted to compare the productive performance of three genotypes of ducks at farmers level with the aim of selecting a suitable genotype of duck for the area. Twenty four farmers were selected for the study. The farmers were divided into two groups of twelve in each for rearing two feed group of ducks viz., supplemental and non supplemental. Each farmer was given eight birds from any three (Khaki Campbell, Jinding and Deshi) genotypes of duck. Sexually mature ducks of three genotypes viz. Khaki Campbell, Jinding and Deshi were distributed to the farmers in order to study the egg production performance and egg quality characteristics.

The expenditure for rearing Khaki Campbell, Jinding and Deshi ducks for egg production for a period of 180 days to 540 days and gross margin has been presented in Table 5

Supplementation of feed to scavenging ducks improves growth, egg productivity, gross margin and reduced mortality. Therefore, duck rearing with supplementary feed may be practiced as an income generating activity among rural haor people. Farmers were economically benefited from the study and showed very positive response for rearing Jinding ducks.

Table 5. Economic performance of three genotypes of ducks from 120 to 540 days of age

Item of expenditure	Supplementary feed group			Non supplementary group		
	Khaki Campbell	Jinding	Deshi	Khaki Campbell	Jinding	Deshi
Cost of duck (Tk.)	130.0	130.0	130.0	130.0	130.0	130.0
Feed cost @ 18.00 Tk./kg	228.6	228.6	228.6	228.6	228.6	228.6
Medicine and vaccination	8.0	8.0	8.0	8.0	8.0	8.0
Miscellaneous	2.0	2.0	2.0	2.0	2.0	2.0
Total variable cost	368.6	368.6	368.6	140.0	140.0	140.0
Selling price of duck @130 Tk./ kg	242.45	232.7	226.2	200.2	195	180.1
Egg sold @7.5Tk. egg	855	840	592.5	600	525	405
Gross return (Tk.)	1097.45	1072.7	818.7	800.2	720	585.1
Gross margin (Tk.)	728.85	704.1	450.1	660.2	580	445.1

Productive performance of three genotypes of laying hen (Sonali, Fayoumi and Deshi Breeds)

Similar to the study with ducks a study was conducted with 3 genotypes of laying hens to compare the productive performance of the genotypes with the aim of selecting a suitable genotype for the area. Methodology for the study was similar to previous study with ducks. The result of the experiment is presented in the following table.

Table 6 Production performance of three genotypes of hens by 360 days

Parameters	Supplementary feed group			Non supplementary group		
	Sonali	Fayoumi	Deshi	Sonali	Fayoumi	Deshi
Number of egg/hen by 360 days	127	163	100	74	100	53
Average egg weight (g/egg)	45.5	44.6	42	44.5	43.2	41
Total egg mass production (kg)	5.79	7.29	4.21	3.32	4.35	2.17
Age at sexual maturity (days)	160	158	185	168	172	186
Survivability (%)	53.125	59.375	65.625	50	59.375	59.37

Fattening of animals through feeding intervention

To disseminate beef fattening technology for year round cash money flow to the farmers through animal fattening program the experiment was carried out with 18 young bulls of different ages. The bulls were raised under free grazing in the haor grassland and with supplementary feeds (mustard oil cake + rice polish in different ratio for different groups) supplied by the project .The growth performance of the bulls were measured for a period of 75 days. The growth rate of local young bulls under improved feeding practices after 75 days of trial showed the weight gain ranged from 960 gd-1 to 1310 gd-1. On average bulls of supplementary a group performed better than those of others. Result showed a net profit of Tk.9489.00 by 75 days of rearing with an investment of Tk.25653.00 to 26778.00 Many farmers showed keen interest to be involved with this type of activities and to continue this program as an income generating means.

Table 7. Average growth performance of bulls belonging different groups

Group	Supplementary feed group				Non supplementary group			
	Initial live weight (Kg)	Final live weight (Kg)	Total live weight (Kg) gain by 75d	Daily live weight gain (Kg)	Initial live weight (Kg)	Final live weight (Kg)	Total live weight gain by 75d	Daily live weight gain (Kg)
A	101.20	200.70	98.20	1.31	101.93	161.67	59.73	0.796
B	168.70	255.00	86.30	1.15	171.67	230.40	58.73	0.780
C	222.70	294.70	72.00	0.96	222.00	273.40	51.40	0.783

Feeding Intervention of Milch Cows for Improving Milk Yield

To improve milk productivity of indigenous cow through feed supplementation the study was conducted with eighteen milking cows of second lactation between 1-10 days of milk production and yielding up to 3 liter of milk. On the basis of milk production the cows were divided into three groups viz., more than 2 liters (A), 1-2 liters (B) and less than 1 liter milk having six animals in each group. These six milking cows of each group further grouped into two viz.,feed supplemented and non supplemented group. Significantly higher milk production were observed on cows fed on supplemented feeding practice The calves belonging to feed supplementary group gained significantly higher body weight than non supplementary groups. Feed supplementation increased net return of Tk. 5122.00 by 4 months of rearing from the cows producing 2.5 Litre of milk/d. Supplementation of concentrate feed is essential for increasing milk production of cows.

Fisheries Component

GIFT/monosex tilapia in cage culture with resource poor farmers

An experiment was undertaken to utilize the vast water body of the Haor and idle man power in monsoon season to perform mono sex and GIFT tilapia culture in cages during August to November 2010 and July to October 2011
The yield of monosex tilapia was higher than that of GIFT tilapia but the economic return was higher in GIFT due to low price of fry. Therefore, community based cage culture of tilapia at haor area may be a profitable venture during lean period. The 3rd experiment is still going on.

Table 8 Performances of mono sex and GIFT tilapia in the haor area.

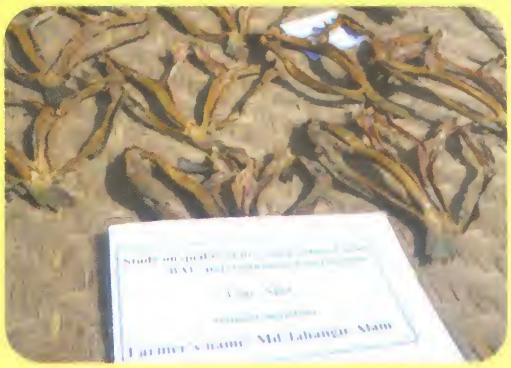
Duration	Species stocked	Stocking density cage-1	Yield kg cage-1	Total Variable cost (Taka cage-1)	Gross return (Taka cage-1)	Gross margin	Benefit cost ratio
1st year	Monosex	864	133.8	7776	9366	1590	1.20
	GIFT	864	131.5	7560	9205	1645	1.21
2nd year	Monosex	1000	64.99	5199	6499	1300	1.25
	GIFT	1000	69.47	5100	6947	1847	1.36

Bio-economic performance of Indian Major Carp with monosex tilapia in seasonal ponds

An experiment was conducted in Purbo Tethulia to bring some ponds and ditches under culture and to uplift the household income and nutrition with Indian major carps by stocking fingerling of Indian Major Carps and monosex tilapia. The experiment was conducted from November 2010 to April 2011. The yield was 4672.1 kg ha-1 with gross return 416,187 kg ha-1 and gross margin 129,667 kg ha-1 with benefit cost ratio 1.45.

Study of Quality Dry Fish

A study was conducted to determine the efficiency of chilli, turmeric, and salt on preservation and quality of dried fish at the study area. Shol (Channa punctatus) was selected for experimental fish.



The results of the study showed that salt treated dried product was superior to other treatments but it contained more moisture (23.15%) than others. Chili treated product showed higher benefit (gross margin 1680) and contained high protein (48.33%) when compare with moisture and 56.79% dry matter basis.

Comparative Study on the Quality of Fish Pickle Prepared from Different Species

The present study was conducted to find out the feasibility of fish pickle preparation for alternative livelihood option and income generating activity through entrepreneurship development in the haor area Spices, onion, ginger, garlic, vinegar, mustard, methi, turmeric and edible oil were used to prepare the pickle. Analysis showed that fish pickle is composed of about 23% crude protein, 43.94 % moisture and 9.96% carbohydrate on moisture basis. However, it contains more crude protein (40.71%) and carbohydrate (17.77%) on dry matter basis. The benefit cost ratio is 1.41.

Rural Hydrology and Mechanization Component

Shallow Tubewell (STW): An Effective Irrigation Device

In order to bring the fallow land under cultivation, a STW was installed during 2011-2012 for a source of irrigation water. One contact farmer irrigated 1.25 acre land by using this STW and got bumper yield of vegetables and spices. During 'rabi' season of 2011-2012, the farmer sold cauliflower, cabbage, tomato, green chili, stem amaranth, lady's finger and Indian spinach amounting Taka 27000, 5000, 23000, 21000, 6500, 7000 and 5000, respectively. In 'boro' season, he irrigated his own and others' rice fields. The fluctuation pattern of ground water level at Purba Tethulia during the irrigation season indicates that it is possible to provide uninterrupted irrigation by using STWs. Two more STWs have been installed by some innovative farmers who were motivated from the success of the STW installed under LIFCHASA. These tubewells are being used successfully for irrigation purpose and, consequently, the farmers are making substantial profit out of their farm products. This is a very positive impact of LIFCHASA activities on irrigated agriculture at Purba Tethulia village.

Integrated Farming System Model Development and Validation

One of the major thrusts of LIFCHASA project is to workable model development for dissemination in the haor ecosystem for over all improvement of livelihood system by appropriate assemblage of component systems/technology for constructing sustainable farming systems from the researcher's menu. Twenty five farming housing households are involved in this activity. Very encouraging results have been obtained. The activity will be continued till the phasing out the project. Maney success stories on livelihood improvement are being emerged and will be reported after full completion of the study.

Success Story

Sultan- a farmer of ingenuity and an entrepreneur of quality vegetable producer

In a Survey made in Purbo Tethulia showed that out of 11.34 ha of land as Kanda, 7.29 ha remained fallow due to of lack of proper knowledge and irrigation. The LIFCHASA Research team took an initiative to utilize these waste land. In order to bring them under cultivation, a STW was installed during 2011-2012 for a irrigation purposes. One participating farmer named Sultan irrigated 1.25 acre (247dec. =1 ha, 100dec. =1 acre) of waste land by using this STW and got bumper yield of vegetables and spices. During

2011-2012, the farmer sold cauliflower, cabbage, tomato, green chili, stem amaranth, lady's finger and Indian spinach amounting Tk. 27000, 25000, 23000, 21000, 6500, 7000 and 5000, respectively. He got technical support from LIFCHASA team by training, frequent field visit and advice. In 'boro' season, he irrigated his own and others' rice fields. . Farmers who were not involved in these activities showed their immense interest to cultivate the winter vegetable in next year by installing more STW.

Noor Jahan is advancing towards to self-sufficiency

Noor Jahan is a landless woman with seven family members. Her husband is a day labor and is passing her days with extreme poor condition. Initially she had local seven ducks and five hens. Noor Jahan was selected for hen rearing on the basis of her previous experience and interest. She was given day long training on hen rearing system and given eight matured hens of Fayoumi breed. She used some eggs for own consumption, some were soldout for cash money and a more number used for natural hatching. She becomes a popular woman in this villege for selling chicks to the villegers. This was a very inspiring example of the neighbors. At present she has 20 hens and earned Tk.5000 and Tk. 2500 by selling 150 chicken and eggs. She spent 3500, 1700, 1200 and 1400 for rickshaw purchases, agriculture, house repairing and education purpose of children, respectively from her earning. She is very pleased and grateful to LIFCHASA Project for the assistance.

Kajol- an ingenuity of integrating farmer

Kajol Mia is a small and marginal farmer. Crop cultivation along with rearing of poultry and duck in small scale was his profession. LIFCHASA Project initiated to develop him as an integrated farmer for his enthusiasm in farming. Initially he had two local ducks and four hens. He was given day long training on duck rearing system and supplied with eight ducks of Jinding breed. At present he has 31 ducks and earned Tk.9000 and Tk.1200 by selling eggs and ducks. He has purchased a milching cow from the income of duck selling with Tk, 15000. On the other hand, he consumed and gifted eggs of equivalent amount of Tk.2200. At the same time he is engaged in the year round homestead vegetable production. In order to utilize water bodies remains under water for six months during monsoon, an initiative was taken to introduce the cage culture in haor ecosytem with Kajol Mia. Monosex and GIFT tilapia was cultivated in cages. Kajol earned Tk.8000 in the first year and Tk.12000 in the second year. He invested Tk.20000 from the income of the cage culture in his grocery business. Inspiring from the previous result, he is now culturing fishes in two cages on his own initiative. By this time he established himself as an entrepreneur by the help of LIFCHASA research team.

Lesson learned

For *haor* ecosystem no suitable *boro* varieties of rice are available which can escape early flash flood. Short duration, cold resistant but high yielding varieties of boro rice are needed.

A treasure of excellent knowledge, skill and innovativeness hidden in the man and woman of the farming community irrespective of farming household, one example of suc h innovativeness are cited here. LIFCHASA set a feeding trial on three breed of chicken viz., Sonali, Fayoumi and Deshi and continued for a year. The trial was practiced by 24 female farmers. The six farmers allowed the deshi cock to cross with Fayoumi hen and eggs were hatched with deshi hen. Three farmers sold chick with Tk. 6000 to 7000. Similarly three other farmers did the same practice and earned Tk. 6000 to 8000.

Conclusion

All these technologies helped a lot to the beneficiaries for their livelihood improvement. The food security for the haor areas may be improved and change the scenario of the haor ecosystem through diversified agricultural activities. These technologies emerged out as highly promising and acceptable to the haor people. It is believed that through the adaption of these technology a revolutionary change may come in *haor* agriculture

Recommendation

The best performed treatment is sufficiently matured to be packaged into technology for upscaling and dissemination

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